US009459397B2

(12) **United States Patent**
Boomgaarden et al.

(10) **Patent No.: US 9,459,397 B2**
(45) **Date of Patent: Oct. 4, 2016**

(54) **EDGE LIT LIGHTING DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 198 days.

(21) Appl. No.: **14/024,280**

(22) Filed: **Sep. 11, 2013**

(65) **Prior Publication Data**

US 2014/0268870 A1 Sep. 18, 2014

Related U.S. Application Data

(60) Provisional application No. 61/777,585, filed on Mar. 12, 2013.

(51) **Int. Cl.**
F21V 7/04 (2006.01)
F21V 8/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/0063*** (2013.01); ***G02B 6/0038*** (2013.01); *G02B 6/0045* (2013.01); *G02B 6/0076* (2013.01)

(58) **Field of Classification Search**
CPC G02B 6/0018; G02B 6/0055; G02B 6/0063; G02B 6/0038; G02B 6/0045; G02B 6/0076
USPC 362/623, 624, 625, 626
See application file for complete search history.

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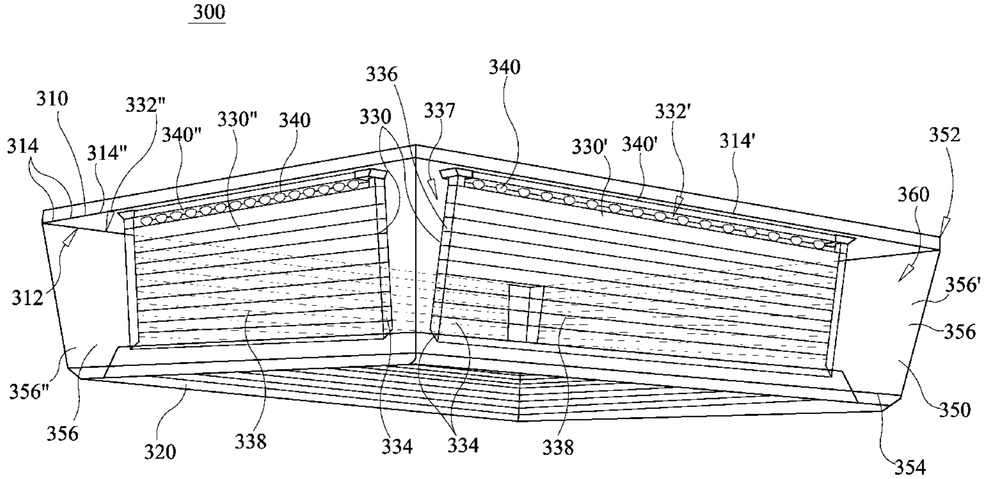
(57) **ABSTRACT**

An edge lit lighting device including a housing, a power circuit, a light source, and an optic. The power circuit may be carried by the housing, and adapted to form an electrical connection with an external power source. The light source may be carried by the housing and electrically connected to the power circuit. The optic may be carried by the housing and positioned in optical communication with the light source. The optic may further include a receiving surface positioned adjacent to the light source, and first and second emitting surfaces. The first emitting surface may include a plurality of features configured to redirect light defined as redirected light in a direction of the second emitting surface, the redirected light being emitted from the second emitting surface. The lighting device may further include pluralities of optics of light sources.

15 Claims, 5 Drawing Sheets



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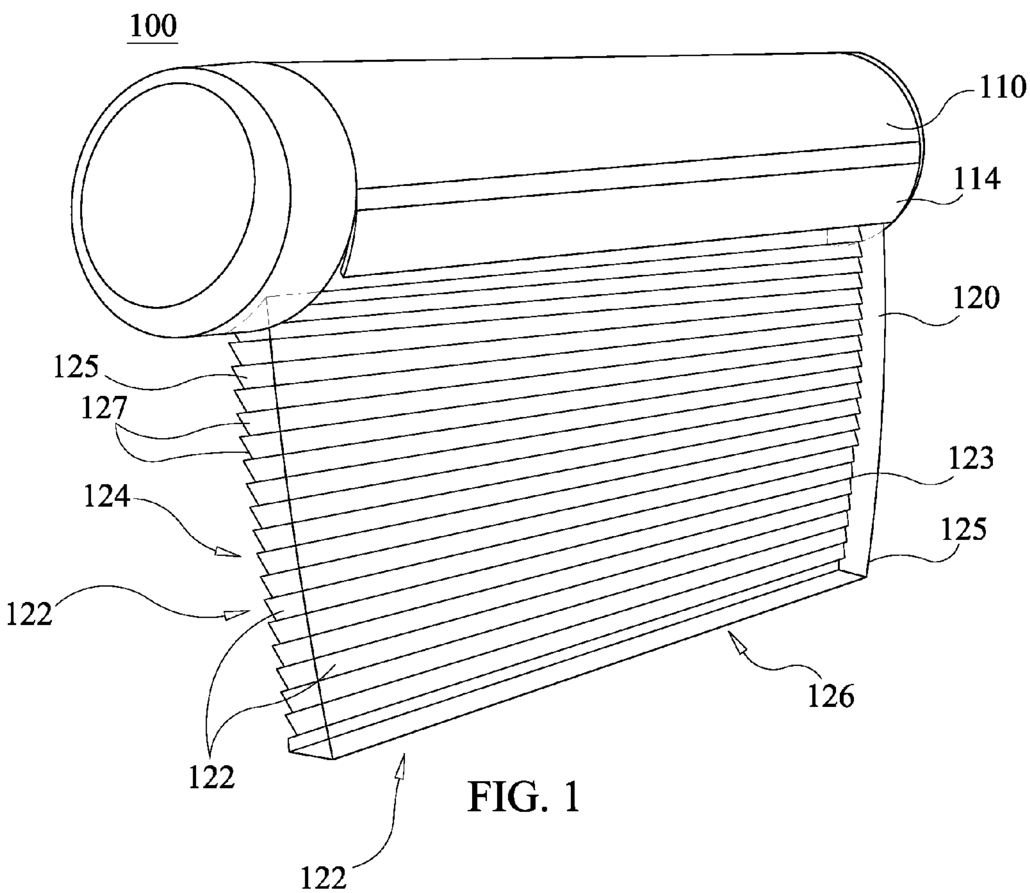
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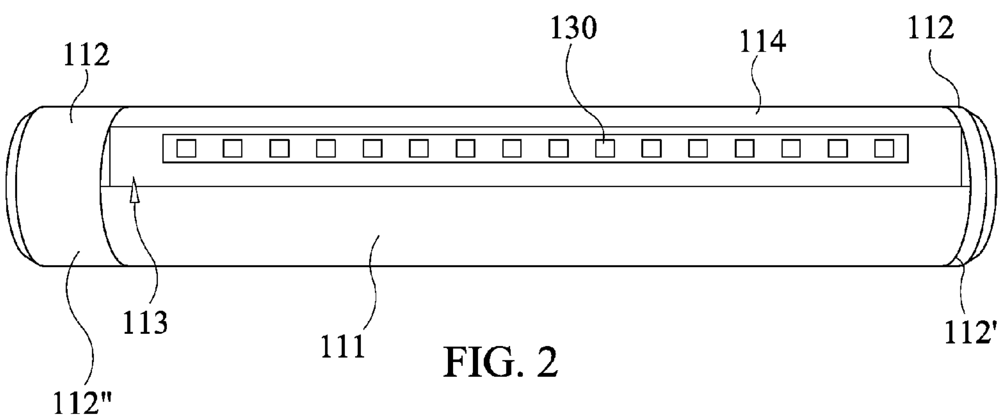
FIG. 1


112
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111
112'
112"

FIG. 2

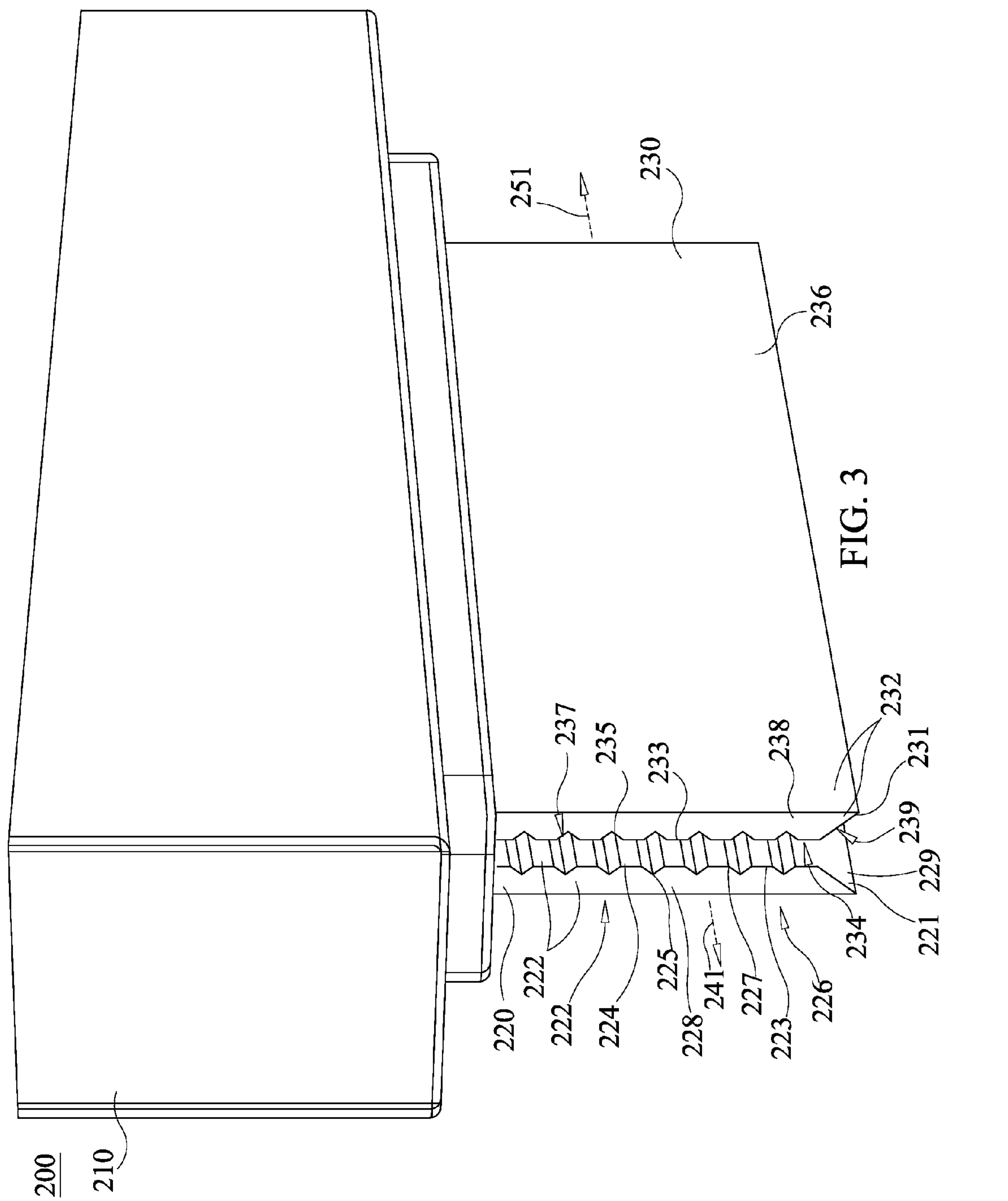
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FIG. 3

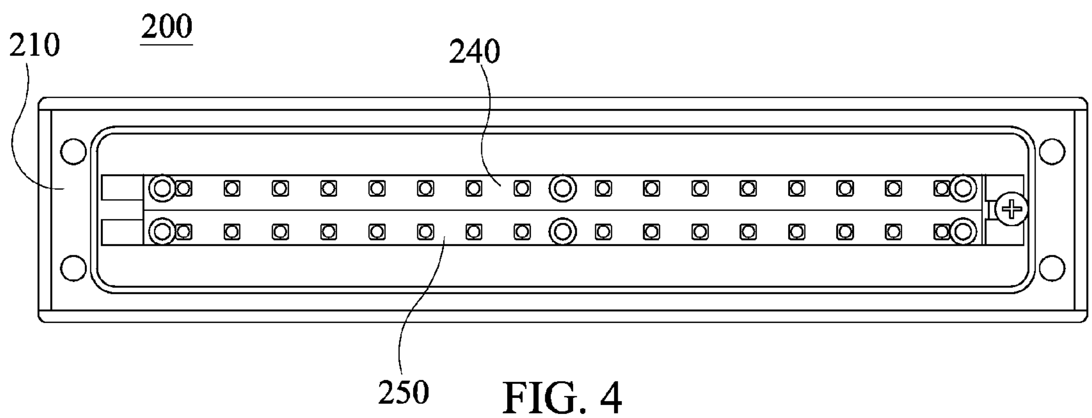
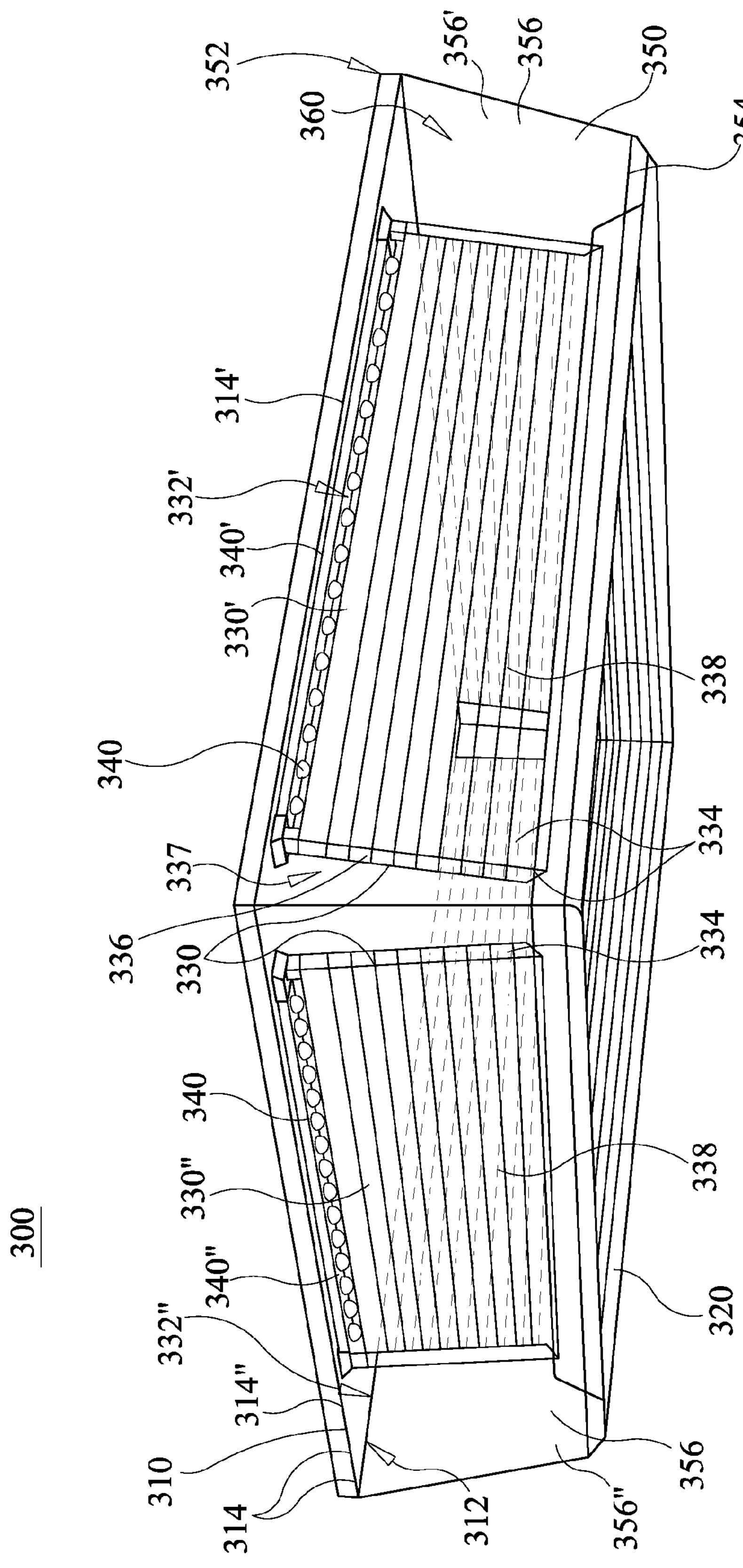


FIG. 4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332"
314"
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356"
356
320

FIG. 5

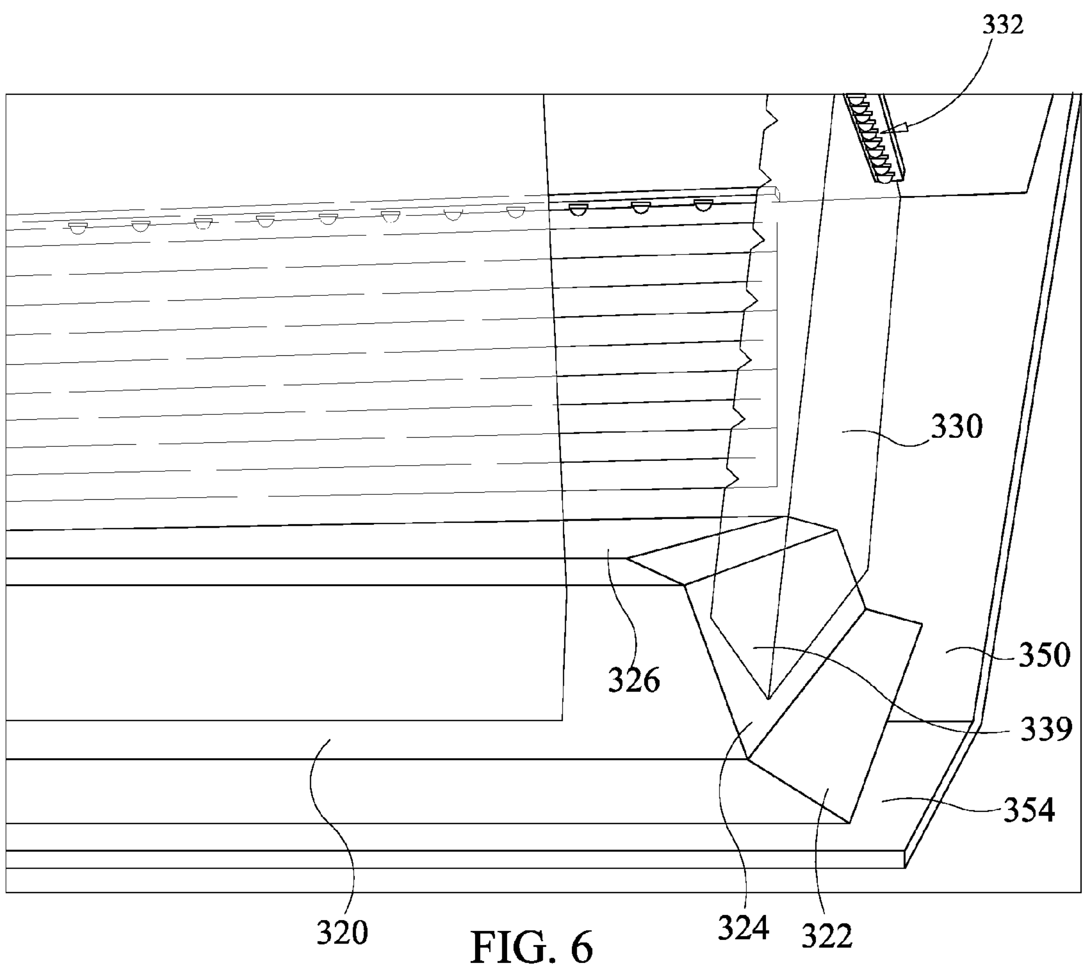

FIG. 6

EDGE LIT LIGHTING DEVICE

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/777,585 titled Edge Lit Lighting Device filed Mar. 12, 2013, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to edge lit lighting devices.

BACKGROUND

Traditionally, lighting fixtures have utilized an approach to lighting where light is configured to pass through an optic along a generally orthogonal propagation path. However, such a method of illumination has the disadvantage of line-of-sight perception of the light source by an observer, and a concentration of light along the line-of-sight that can be uncomfortable when perceived. Moreover, solutions to this problem usually include the use of a diffusive element, generally reducing the efficiency in lighting, requiring either acceptance of reduced illuminating efficiency or an increased consumption of power to provide the desired illumination.

Edge lighting has been used in non-illuminating industries, including illumination of decorative glass, particularly with etching, and in providing backlighting in television sets. However, such systems do not provide sufficient brightness for illuminating purposes. Accordingly, there is a need in the art for an edge lit lighting device.

SUMMARY

In an embodiment of the invention there is presented an edge lit lighting device. The lighting device may include a housing, a power circuit, a light source, and an optic. The power circuit may be carried by the housing, and may be adapted to form an electrical connection with an external power source. The light source may be carried by the housing and electrically connected to the power circuit. The optic may be carried by the housing and positioned in optical communication with the light source.

The optic may further include a receiving surface positioned adjacent to the light source, and first and second emitting surfaces. The first emitting surface may include a plurality of features configured to redirect light defined as redirected light in a direction of the second emitting surface, the redirected light being emitted from the second emitting surface. In some embodiments, the features are a series of horizontal and slanted sections. In some embodiments, the features are a series of first slanted sections, vertical sections, and second slanted sections. Furthermore, the light source may be positioned so as to emit light in a direction substantially perpendicular to the direction light is emitted from the second emitting surface. Additionally, the optic may be configured to extend generally outward from the housing.

In additional embodiments, the lighting device may include a second light source and a second optic, each similarly carried by the housing and being similar or identical to the original optic and light source. The optics may be positioned generally parallel to each other, or may be generally non-parallel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an edge lit lighting device according to an embodiment of the present invention.

FIG. **2** is a bottom view of the lighting device depicted in FIG. **1** with an optic of the lighting device removed.

FIG. **3** is a perspective view of an edge lit lighting device having two optics according to an embodiment of the invention.

FIG. **4** is a bottom view of the lighting device of FIG. **3** with the optics removed.

FIG. **5** is a lower perspective view of a lighting device having for optics according to an embodiment of the invention.

FIG. **6** is a partial side elevation view of the lighting device of FIG. **5**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Those of ordinary skill in the art realize that the following descriptions of the embodiments of the present invention are illustrative and are not intended to be limiting in any way. Other embodiments of the present invention will readily suggest themselves to such skilled persons having the benefit of this disclosure. Like numbers refer to like elements throughout.

Although the following detailed description contains many specifics for the purposes of illustration, anyone of ordinary skill in the art will appreciate that many variations and alterations to the following details are within the scope of the invention. Accordingly, the following embodiments of the invention are set forth without any loss of generality to, and without imposing limitations upon, the claimed invention.

In this detailed description of the present invention, a person skilled in the art should note that directional terms, such as “above,” “below,” “upper,” “lower,” and other like terms are used for the convenience of the reader in reference to the drawings. Also, a person skilled in the art should notice this description may contain other terminology to convey position, orientation, and direction without departing from the principles of the present invention.

Furthermore, in this detailed description, a person skilled in the art should note that quantitative qualifying terms such as “generally,” “substantially,” “mostly,” and other terms are used, in general, to mean that the referred to object, characteristic, or quality constitutes a majority of the subject of the reference. The meaning of any of these terms is dependent upon the context within which it is used, and the meaning may be expressly modified.

Throughout this disclosure, the present invention may be referred to as relating to luminaires, digital lighting, light sources, and light-emitting diodes (LEDs). Those skilled in the art will appreciate that this terminology is only illustrative and does not affect the scope of the invention. For instance, the present invention may just as easily relate to lasers or other digital lighting technologies. Additionally, a person of skill in the art will appreciate that the use of LEDs within this disclosure is not intended to be limited to any specific form of LED, and should be read to apply to light emitting semiconductors in general. Accordingly, skilled artisans should not view the following disclosure as limited to any particular light emitting semiconductor device, and should read the following disclosure broadly with respect to the same.

Furthermore, while the invention is directed to an edge lit lighting device, terms such as "lighting device," "luminaire," "security light," and "light" are used for the convenience of the reader, may be used interchangeably, and do not in any way limit or stray from the invention.

An embodiment of the invention, as shown and described by the various figures and accompanying text, provides an edge lit lighting device. The edge lit device may be generally frameless on many sides, permitting light to be emitted in a substantial majority of a sphere surrounding the edge lit lighting device. Additionally, the edge lit lighting device may be configured to emit light primarily in a first direction, while light may be emitted in other directions secondarily. In some embodiments, the lighting device may be employed as a security light.

Referring now to FIG. **1**, an edge lit lighting device **100** according to an embodiment of the present invention is depicted. The lighting device **100** may include a housing **110**, an optic **120**, and a light source **130** (shown in FIG. **2**). The light source **130** may be carried by the housing **110** and positioned such that light emitted thereby enters the optic **120**. The optic **120** may be formed of a transparent or translucent material that is configured to receive light from the light source **130** and refract, reflect, or otherwise redirect light to be emitted from a surface of the optic **120**. The optic **120** may be configured to extend outward from the housing **110**, in the present embodiment extending generally downward.

Referring now to FIG. **2**, the housing **110** will now be discussed in greater detail. The housing **110** may be generally configured to carry each of the optic **120** and the light source **130**. Accordingly, the housing **110** may be configured to permit attachment of the optic **120** and the light source **130** thereto. Each of the optic **120** and the light source **130** may be attached according to any mean, method, or use of any device known in the art. Types of attachments may include, but are not limited to, fasteners, clasps, glues, adhesives, welding, interference fits, and any other method known in the art.

The housing **110** may further include an outer surface including an attachment surface. The attachment surface may be configured to facilitate the attachment of the lighting device **100** to a structure, such as a wall, ceiling, or pole. The attachment surface may include any feature to facilitate such attachment, such as a generally flat surface, holes, including holes configured to cooperate with a fastener, such as a screw. It is contemplated that any method of attachment known in the art may be embodied in and facilitated by the attachment surface.

The housing **110** may be fabricated of any material to which the optic **120** and the light source **130** may be attached. Moreover, the housing **110** may be fabricated of a material having desirable characteristics, including weight, strength-to-weight ratio, cost, fabrication time, formability, durability, chemical reactance, and thermal dissipation capacity. For example, and not by means of limitation, the housing **110** may be fabricated from metals, metal alloys, plastics, polymers, and any other suitable material.

The housing **110** may include a center member **111** and one or more end members **112**. The center member **111** may be configured to include a void **113**. The void **113** may be configured to permit each of the optic (not shown) and the light source **130** to be positioned therein. Moreover, the void **113** may be defined by features of the center member **111** to which each of the optic and the light source **130** may be attached thereto. The void **113** may further be defined by each of the end members **112**. Additionally, the void **113** may be configured to permit circuitry associated with the light source **130** therein. For example, the void **113** may be configured to permit one or more printed circuit boards (PCBs) therein, the PCBs including circuitry necessary to provide power for the light source **130**, and circuitry necessary to drive and control the operation of the light source **130**. Furthermore, the housing **110** may include holes, openings, apertures, or any other feature to facilitate the electrical connection between the light source **130** and its associated circuitry, as well as between the circuitry and an external power source. In some embodiments, the circuitry may further include a battery, in some further embodiments a rechargeable battery that permits the operation of the lighting device **100** without an electrical connection to an external power source.

In some embodiments, the end members **112** may be similarly sized. In some other embodiments, the end members **112** may be sized differently. As depicted in FIG. **2**, a first end member **112'** is smaller when compared to a second end member **112"**. In some embodiments, the second end member **112"** may be configured to define a void (not shown) to permit the positioning therewithin of various elements of the lighting device **100**. For example, the circuitry associated with the light source **130** may be positioned within the void of the second end member **112"** instead of the void **113** of the center member **111**. In some further embodiments, another electrical device and/or circuitry associated therewith may be positioned within the void. Furthermore, in some embodiments, the end piece **112"** may include an opening, aperture, or port permitting communication between the void and the environment surrounding the lighting device **100**. The type of communication may be fluid, electromagnetic, atmospheric, or permit the positioning of an element therethrough. Types of electrical devices may include light sensors, occupancy sensors, movement sensors, gas sensors, communication devices, global positioning system (GPS) devices, timing devices, such as an atomic clock, and any other electrical device. Moreover, the electrical device may be placed in electrical communication with the circuitry associated with the light source **130**, and the associated circuitry may operate the light source **130** responsive to communications received from the electrical device. Furthermore, it is appreciated that in some embodiments the electrical device may be positioned within the void **113**.

The housing **110** may fabricated of a material having desired characteristics. For example, the housing may be fabricated of a material having desirable thermal characteristics, such as desired heat dissipation capacity. In some embodiments, the housing **110** may be positioned in thermal communication with heat generating elements of the lighting device **100**, such as, for example, the light source **130**. In such embodiments, the housing **110** may dissipate heat generated by the light source **130** to maintain a desired operating temperature of the light source **130**. In some embodiments, the housing **110** may further include structural features to increase the thermal dissipative capacity of the housing **110**. Those features may include, but are not limited to, fins, openings, grooves, and the like. Additionally, in some embodiments, the lighting device may further include an active heat sink element. The active heat sink element may be the electrical device described hereinabove. Furthermore, the active heat sink may, in some embodiments, be a fan. In some other embodiments, the active heat sink element may be the device described in U.S. patent application Ser. No. 13/107,782 titled Sound Baffling Cooling System for LED Thermal Management and Associated Methods filed May 13, 2011, the content of which is incorporated in its entirety herein.

Referring now back to FIG. **1** and additionally to FIG. **2**, additional aspects of the body member **110** will be discussed in greater detail. The body member **110** may further include a light shield **114**. The light shield **114** may be configured to generally obscure the light source **130** from being directly perceivable from the environment surrounding the lighting device **100**. Accordingly, the light shield **114** may be configured to extend from the center member **111** such that light emitted by the light source **130** is either absorbed or reflected by the light shield **114**. The length and direction of the extension of the light shield **114** may be configured such that light emitted by the light source **130** is perceivable only after traversing through and being emitted by the optic **120**.

Continuing to refer to FIG. **1**, the optic **120** will now be discussed in greater detail. The optic **120** may be carried by the housing **110** and positioned in optical communication with the light source **130** such that light emitted by the light source is received by the optic **120**. Accordingly, the optic **120** may include a receiving surface (not shown) positioned adjacent the light source **130**. The optic may further include a plurality of emitting surfaces **122**. The number and configuration of the emitting surfaces **122** will depend on the configuration of the optic **120**. More specifically, the geometric configuration of the optic **120** will determine the number and shape of the emitting surfaces **122**. In the present embodiment, the optic **120** is configured to have a generally rectangular geometric configuration. Accordingly, the emitting surfaces may include a front surface **123**, a rear surface **124**, side surfaces **125**, and a lower surface **126**. In most embodiments, the geometric configuration of the optic **120** will be such that it includes the front surface **123** and the rear surface **124**. Other geometric configurations include, but are not limited to, ovals, semicircles, triangles, and any other geometric configuration. Moreover, each of the receiving surface and the various emitting surfaces **122** may be formed so as to have a selected shape, including, but not limited to, rectangles, ovals, triangles, ellipses, and any other geometric configuration, including non-regular configurations.

The optic **120** may be configured to emit light generally uniformly across the individual emitting surfaces **122**. That is to say, while light emitted from one emitting surface **122** may be different in proportion to light emitted by another emitting surface **122**, light emitted from the surface area of a single emitting surface **122** may be generally uniform. The uniformity may apply to a left-to-right perspective, a top-to-bottom perspective, or both. The uniformity of light emitted by the emitting surfaces may depend on the light emitted by the light source **130** as well as the configuration of the optic **120**, including the configuration of each of the emitting surfaces **122**.

The optic **120** may be configured to primarily emit light from one of the emitting surfaces **122**. The relative proportion of light emitted by one of the emitting surfaces **122** compared to the other emitting surfaces **122** may be determined by a number of factors, including surface features, relative surface area, and direction relative to the light source **130**.

In some embodiments, one or more of the emitting surfaces **122** may include surface features configured to alter the emission pattern of light therefrom. For example, in the present embodiment, each of the front surface **123**, the side surfaces **125**, and the lower surface **126** have generally smooth surfaces, generally permitting light to be emitted therefrom without impediment. Furthermore, in the present embodiment, the rear surface **124** comprises a plurality of features **127**. The plurality of features **127** may be configured to generally reflect, refract, or otherwise redirect light from the rear surface **124** such that light is inhibited from being emitted from the rear surface **124**. The plurality of features **127** may include any optical features known in the art to reflect, refract, or otherwise redirect light incident thereupon or therethrough. In the present embodiment, the plurality of features **127** may include alternating generally horizontal sections and slanted sections. As such, light that is transmitted through the optic **120** and incident upon the plurality of features **127** may be generally reflected, refracted, or otherwise redirected such that is substantially redirected away from and not emitted by the rear surface **124**.

The light redirected by the plurality of features **127** may be redirected in the direction of the other emitting surfaces **122**. Furthermore, where the optic **120** is configured to have a principal emitting surface, the plurality of features **127** may be configured to redirect light primarily in the direction of the principal emitting surface. In the present embodiment, where the front surface **123** is a principal emitting surface, the plurality of features may be configured to redirect light primarily in the direction of the front surface **123**.

Additionally, the emitting surfaces **122** may further include a coating, application, or other additional material positioned adjacent the emitting surface to further reflect, refract, or otherwise redirect light therefrom. For example, in some embodiments, the rear surface **124** may further include a reflective surface applied thereto, for example applied to the plurality of features **127**, to reflect light back into the optic **120**, thereby preventing light from being emitted therefrom. Such an additional feature may be selectively incorporated into any of the emitting surfaces **122**.

Furthermore, in some embodiments, one or more of the emitting surfaces **122** may include a color conversion layer. The color conversion layer may be configured to receive light within a first wavelength range and emit a converted light within a second wavelength range. More disclosure related to color conversion layers may be found in U.S. patent application Ser. No. 13/234,604 titled Remote Light Wavelength Conversion Device and Associated Methods filed Sep. 16, 2011, the content of which is incorporated in its entirety herein.

Another characteristic of the emitting surfaces **122** that will determine the amount of light emitted thereby is the relative surface of an emitting surface **122** compared to the other emitting surfaces **122**. Generally, not considering other factors, an emitting surface **122** with a relatively larger surface area will emit a greater proportion of light than an emitting surface **122** with a relatively smaller surface area. Accordingly, the emitting surfaces **122** may be configured to have varying surface areas to alter from what surface, and by extension in what direction, light will be emitted. In the present embodiment, each of the front surface **123** and the rear surface **124** have surface areas that are larger than the surface areas of the side surfaces **125** and the lower surface **126**. Accordingly, not accounting for the plurality of features

127, each of the front surface **123** and the rear surface **124** will generally emit more light than the side surfaces **125** and the lower surface **126**.

Additionally, the optic **120** may include other characteristics to impact how light is emitted by the optic **120**. For example, the optic **120** may include a curvature to alter the emission characteristics of the emitting surfaces **122**. In the present embodiment, the optic **120** includes a curvature such that front surface **123** is generally convex, and the rear surface **124** is generally concave. Accordingly, light emitted by the front surface **123** may be generally more divergent upon emission from therefrom, and light emitted by the rear surface **124** may be more convergent upon emission therefrom. The optic **120** may include a curvature in any manner that affects the emission of light from the emitting surfaces **122**.

Notably, the optic **120** is attached to the housing **110** only generally towards the upper end of the optic **120**. There are no other structural members attached to the optic **120** or providing any structural support. Moreover, as the light source **130** is carried by and positioned adjacent the housing **110**, there are no other additional light sources along the length of the optic **120**. Accordingly, the optic **120** has no need for any structural elements that would otherwise cover the side surfaces **125** and/or the lower surface **126**. Therefore, the lighting device **100** may be generally frameless about the sides and bottom of the optic **120**, and light may be emitted from the aforementioned surfaces.

The optic **120** may be configured to emit light in primarily one direction. That primary direction may be associated with one of the emitting surfaces **122**, in that one emitting surface **122** may emit light principally in the primary direction. In the present embodiment, the optic **120** is configured to emit light in a direction associated with the direction of emission from the front surface **123**. Accordingly, the optic **120**, in this particular embodiment, is configured to include a number of characteristics designed to increase the emission of light from the front surface **123**. The characteristics include the surface area of the front surface **123** and the plurality of features of the rear surface **124**, which are configured to redirect light in the direction of the first surface **123** through the optic. Furthermore, the curvature of the optic **120** further affects the direction of light emitted by the front surface **123** to be divergent therefrom, thereby illuminating a broader area compared to embodiments where the optic **120** does not include a curvature. These and any other characteristic of the optic **120** may cooperate to affect the emission of light by the optic **120**.

Referring now to FIG. **2**, the light source **130** will now be discussed in greater detail. The light source **130** may be any light emitting element that may cooperate with the optic **120** to emit light as described hereinabove. The light source may be, for example, incandescent lights, fluorescent lights, light-emitting semiconductors such as light emitting diodes (LEDs), arc lights, halogen lights, and any other device known in the art. In the present embodiment, the light source **130** may include a plurality of LEDs. The light source **130** may be positioned in electrical communication with the associated circuitry described hereinabove, the associated circuitry being positioned within at least one of the void **113** and the void of the second end member **112"**. Furthermore, the light source **130** may receive electrical power from a power circuit of the associated circuitry, the power circuit being configured to supply the light source of appropriate current and conditioning for the operation of the light source **130**. Additionally, the light source **130** may be operated by a driver circuit of the associated circuitry.

The light source **130** may be positioned so as to emit light generally in the direction of the optic **120** (shown in FIG. **1**). The light source **130** may be configured to emit light approximately uniformly across the receiving surface of the optic **120**. Furthermore, the light source **130** may be configured to emit light such that the optic **120** emits light approximately uniformly from a left-to-right perspective. In the present embodiment, the light source **130** may include a plurality of LEDs positioned in a spaced apart arrangement. The plurality of LEDs may be spaced at approximately uniform intervals and run across the substantial length of the void **113** such that the LEDs are collinear. The plurality of LEDs may include LEDs of similar types, or it may include LEDs of varying types. The LEDs may vary by the type of light emitted, including brightness, color, color temperature, color rendering index (CRI), and any other characteristic of art known in the industry. The light emitted by the plurality of LEDs may combine to form a combined light. The LEDs forming the plurality of LEDs may be selected to have individual characteristics that, when combined, form a combined light having desired characteristics. In some embodiments, the combined light may be a white light. In some embodiments, the combined light may have a CRI of 90 or above. In some embodiments, the combined light may have a color temperature within the range from about 2,000 Kelvin to about 8,000 Kelvin. In some embodiments, the combined light may have a brightness within the range from about 500 lumens to about 10,000 lumens.

Referring now to FIGS. **3** and **4**, another embodiment of the present invention is depicted. A lighting device **200** is presented therein having substantial similarity to the light device **100** depicted in FIGS. **1** and **2**, selectively including any and all of the characteristics, elements, and features as described hereinabove. The lighting device **200** may include a housing **210**, a first optic **220**, a second optic **230**, a first light source **240**, and a second light source **250**. The housing **210** may be generally the same as the housing **110** of FIGS. **1** and **2**, with the exception that the housing **210** is configured to carry two optics and two light sources. Moreover, in the present embodiment, the housing **210** is configured to be attached to a ceiling.

Similar to the housing **210**, each of the first and second optics **220**, **230** may be substantially similar to the optic **120** as depicted in FIGS. **1** and **2**, selectively including any and all of the characteristics, elements, and features as described hereinabove. The optics **220**, **230** may each have a receiving surfaces (not shown) and a plurality of emitting surfaces **222**, **232**, including a first emitting surface **224**, **234**, a second emitting surface **226**, **236**, side emitting surfaces **228**, **238**, and a lower emitting surface **229**, **239**. Each of the respective surfaces may have characteristics similar or identical to those surfaces of the optic **120**.

In the present embodiment, the first emitting surfaces **224**, **234** may each comprise a plurality of features in the form of a plurality of vertical sections **223**, **233**, a plurality of first slanted sections **225**, **235**, and a plurality of second slanted sections **227**, **237**, all of which may be configured to redirect light in the direction of the second emitting surface **226**, **236**. The first slanted sections **225**, **235** may be configured to be at a first angle relative to the vertical sections **223**, **233**, and the second slanted sections **227**, **237** may be configured to be at a second angle relative to the vertical sections **223**, **233**. Each of the first and second angles may be configured so as to redirect light in the direction of one of the emitting surfaces **222**, **232**, such as the second emitting surface **226**, **236**. Moreover, each of the vertical sections **223**, **233**, the first slanted sections **225**, **235**, and the second slanted sections **227**, **237** may be configured to include features to enhance the redirection of light therefrom, including surface texturing and the application of a reflective material thereto. Moreover, each of the optics **220**, **230**, may further include a tapered end **221**, **231** that tapers from the first emitting surface **224** in the direction of the second emitting surface **226**. The tapered ends **221**, **231** may be configured to have an angle approximately equal to the angle of the second slanted sections **227**, **237**, or they may be configured to have an angle that is unequal. The tapered ends **221**, **231** may define the lower surfaces **228**, **238**, of the optics **220**, **230**.

In some embodiments, the optics **220**, **230** may be formed so as to be identical to one another. In some embodiments, the optics **220**, **230** may be formed so as to have differences, in such examples as shape, size, distribution of light emitted thereby, and any other characteristic. Moreover, the housing **210** may be configured so as to define the position and orientation of the optics **220**, **230**, to each other. In the present embodiment, the housing **210** is configured to carry the optics **220**, **230** generally about parallel to each other such that their respective second emitting surfaces **226**, **236** face each other, and such that their respective first emitting surfaces **224**, **234** face generally away from each other, in opposite directions. More specifically, each of the first and second optics **220**, **230** may define respective longitudinal horizontal axes **241**, **251**, and the optics **220**, **230** may be carried by the housing **210** such that each respective longitudinal horizontal axes are parallel or about parallel too each other. In other embodiments, the housing **210** may be configured to carry the optics **220**, **230** in any non-parallel orientation. More specifically, the optics **220**, **230** may be carried by the housing **210** such that each respective longitudinal horizontal axes are non-parallel too each other, such as, for example, about perpendicular. Additionally, in some embodiments, the housing **210** may be configured to permit the first optic **220** to attach at a first elevation and the second optic **230** to attach at a second elevation.

Similar to the housing **210** and the optics **220**, **230**, each of the first and second light sources **240**, **250** may be substantially similar to the light source **130** of FIGS. **1** and **2**, selectively including any and all of the characteristics, elements, and features as described hereinabove. The first light source **240** may be associated with the first optic **220** such that light emitted by the first light source **240** is incident upon and received mostly or entirely by the first optic **220**, and the second light source **250** may be associated with the second optic **230** such that light emitted by the second light source **250** is incident upon and received mostly or entirely by the second optic **230**. Additionally, the housing **210** may be configured to carry the first and second light sources **240**, **250** in the same position and orientation with respect to each other as between the first and second optics **220**, **230**.

In some embodiments, the first and second light sources **240**, **250** may be configured to be similar or identical. For example, each may be configured to emit light in the same distribution across their respective associated optic, and each may be configured to emit light such that light emitted the their respective optics are similar or identical. In some embodiments, the first light source **240** may be configured to emit light having a first characteristic, and the second light source **250** may be configured to emit light having a second characteristic. Moreover, each of the first and second light sources **240**, **250** may be operated to vary individual characteristics of light emitted thereby. The types of characteristics that may vary between and within the first and second light sources **240**, **250** includes, but is not limited to, brightness, color, color rendering index, spectral power distribution, and the like.

Additionally, in some embodiments, the lighting device **200** may be used to convey information. For example, the driver circuit, as recited hereinabove, may be configured to operate the first light source **240** to emit light within a first wavelength range corresponding to a first color, and the second light source **250** to emit light within a second wavelength range corresponding to a second color. For example, the first color may be red, indicating to an observer that danger may be present in the direction of the lighting device **200** and continuing in that same direction from the perspective of the observer. Furthermore, the second color may be green, indicating an absence of danger in the direction of the lighting device **200** and continuing in that same direction from the perspective of the observer. More information related to such a communication system may be found in U.S. patent application Ser. No. 13/969,103 entitled Luminaire to Emit Light Responsive to an Emergency Alert and Associated Methods filed Aug. 16, 2013, the content of which is incorporated by reference in its entirety herein.

Referring now to FIG. **5**, an additional embodiment of the present invention is depicted. In this embodiment, a lighting device **300** may include an upper housing **310**, a lower housing **320**, a plurality of primary optics **330**, a plurality of light sources **340**, and a secondary optic **350**. As in the previous embodiments of the invention, particularly the lighting device **200**, each light source **340** of the plurality of light sources **340** may be associated and positioned in optical communication with an optic **330** of the plurality of primary optics **330**. More specifically, a first light source **340'** may be positioned in optical communication with a receiving surface **332'** of a first primary optic **330'**. Similarly, a second light source **340"** may be positioned in optical communication with a receiving surface **332"** of a second primary optic **330"**. This type of association and positioning in optical communication may be applied to pairs of light sources **340** and primary optics **330** until each light source **340** of the plurality of light sources **340** is positioned in optical communication with a receiving surface **332** of a primary optic **330** of the plurality of primary optics **330**. In the present embodiment, the plurality of primary optics **330** includes four optics **330**, and the plurality of light sources **340** similarly includes four light sources **340**. It is contemplated an included within the scope of the invention that each primary optic **330** of the plurality of primary optics **330** may be associated and positioned in optical communication with more than one light source **340**, or that more than one primary optic **330** of the plurality of primary optics **330** may be positioned in optical communication with a single light source **340**.

The upper housing **310** may be configured to define an upper section of the lighting device **300**. Additionally, the upper housing **310** may be configured to permit various elements of the lighting device **300** to be attached thereto and carried thereby. For example, in the present embodiment, each light source **340** of the plurality of light sources **340** may be attached to and carried by a lower surface **312** of the upper housing **310**. Furthermore, in some embodiments, the plurality of primary optics **330** may be attached to and carried by the plurality of light sources **340**. The lower surface **312** may be configured so as to facilitate the attachment of elements of the lighting device **300** thereto. In the present embodiment, the lower surface **312** may have a generally flat configuration. In some other embodiments, the lower surface **312** may be configured to have a generally curved configuration. In such embodiments, the lower surface to **312** may have either of a generally convex or a generally concave curvature. Furthermore, the upper housing **310** may have a geometric configuration so as to define a shape of the lower surface **312**. In the present embodiment, the lower surface **312** is generally square in shape. Any other geometric configuration is contemplated included within the scope of the invention, including, but not limited to, circles, ellipses, ovoids, triangles, rectangles, and any other polygon. Additionally, in some embodiments, the lower surface **312** may be configured to have a texture comprising a plurality of grooves, raised or recessed sections, and the like. Moreover, in some embodiments, the lower surface **312** may be configured to be reflective, reflecting light incident thereupon.

Furthermore, the shape of the lower surface **312** may be configured to have the same number of sides as there are primary optics **330** in the plurality of primary optics **330**, the sides of the shape of the lower surface **312** each defining an edge **314** of the lower surface **312**. In such embodiments, each edge **314** may be associated with a primary optic **330** of the plurality of primary optics **330**. For example, a first edge **314'** may be associated with a first primary optic **330'**, and a second edge **314"** may be associated with a second primary optic **330"**. This type of association may be established between each edge **314** and a primary optic **330** of the plurality of primary optics **330**.

Each light source **340** of the plurality of light sources **340** may be attached to the lower surface **312** such that each primary optic **330** associated with each light source **340** emits light in a selected direction. Generally, each light source **340** may be attached to the lower surface **312** in proximity to an edge **314** and away from a center of the lower surface **312**. The direction in which light is selected to be emitted will determine the position on the lower surface **312** at which each light source **340** is attached. More specifically, each light source **340** may be positioned in proximity to an associated edge **314**. The edge **314** which each light source **340** is associated may be the same edge **314** with which primary optic **330** associated with the light source **340** is associated with. For example, a first light source **340'** may be associated with a first edge **314'** and a second light source **340"** may be associated with a second edge **314"**. Each light source **340** of the plurality of light sources **340** may be associated with an edge **314** such that every light source **340** is associated with an edge **314**. Where each light source **340** is generally elongate in defines a longitudinal axis, the longitudinal axis of each light source **340** may be about parallel to a line defined by its associated edge **314**. In some embodiments, a single light source **340** may be associated with more than one edge **314**. In some other embodiments, a single edge **314** may be associated with more than one light source **340**. Accordingly, the number of light sources **340** included in the plurality of light sources **340** may be, in some embodiments, equal to the number of sides defined by the shape of the lower surface **312**, and in some other embodiments, may be fewer than or greater than the number of sites defined by the shape of the lower surface **312**.

Additionally the upper housing **310** may be configured to facilitate the electrical coupling of each light source **340** of the plurality of light sources **340**. This may be accomplished by the upper housing **310** including an internal cavity (not shown). The internal cavity may be configured to permit electrical connectors, such as wires, to be positioned therein, facilitating electrical coupling between each light source **340** and a circuit configured to enable and control the operation of each light source **340**. For example, at least one of a power circuit and a driver circuit may be positioned within the internal cavity and electrically coupled to wires that are electrically coupled to each light source **340** of the plurality of light sources **340**, thereby electrically coupling and positioning in electrical communication either or both of the power circuit and the driver circuit with the light sources **340**. Furthermore, either of the power circuit and the driver circuit may be positioned in electrical communication with an external power source, as described hereinabove.

The upper housing **310** may further be configured to permit the attachment of the secondary optic **350** thereto, carrying the secondary optic **350** thereby. In some embodiments, the secondary optic **350** may be configured to conform to the shape of the lower surface **312**. Accordingly, in the present embodiment, the secondary optic **350** is configured to have a generally box-like shape, such that an upper section **352** of the secondary optic **350** interfaces with the edges **314** of the upper housing **310**. Moreover, the edges **314** may be configured to permit the attachment of the secondary optic **350** thereto by any means or method known in the art, including, but not limited to, glues, adhesives tang-and-slot systems, interference fits, fasteners, welding, and the like. The attachment of the secondary optic **350** to the upper housing **310** may partially define an optical chamber **360** within which the plurality of primary optics **330** and the plurality of light sources **340** may be positioned. Furthermore, the attachment between the secondary optic **350** and the lower surface **312** may form a fluid seal therebetween, partially sealing the optical chamber **360** from the environment surrounding the lighting device **300**.

The upper housing **310** may be configured to be attached to a surface of an external structure as described hereinabove. For example, in the present embodiment, the upper housing **310** may be configured to be attached to a ceiling. The method of attachment may be any of those disclosed hereinabove.

The secondary optic **350** may be formed of any transparent or translucent material. Furthermore, the secondary optic **350** may be configured to cause light to be emitted from the lighting device **300** and a selected distribution. Accordingly, in some embodiments, the secondary optic **350** may include structural features and characteristics to refract reflects or otherwise redirect light such that light emitted by the lighting device **300** has the selected distribution. In some embodiments, the secondary optic **350** may collimate light passing therethrough. In some embodiments, the secondary optic **350** may diffuse light passing therethrough. In the present embodiment, the secondary optic **350** may be configured such that the upper section **352** defines a shape that is generally larger than a shape defined by a lower section **354** of the secondary optic **350**. As a result of this, the various sections **356** between the upper section **352** and the lower section **354** may be slanted. In some embodiments, such a slant may result in the redirection of light passing through the secondary optic **350**, generally downward. It is contemplated included within the scope of the invention that the secondary optic **350** may be configured to redirect light passing therethrough in any direction.

In some embodiments, the secondary optic **350** may be configured to include a color conversion layer. The color conversion layer may be substantially the same as or identical to the color conversion layer as described hereinabove. Such a color conversion layer may be in addition to a color conversion layer of any other element of the lighting device **300**, including the plurality of primary optics **330**, or such a color conversion layer may be the only color conversion layer of the lighting device **300**.

It is contemplated and within the scope of the invention that a secondary optic, similar to the secondary optic **350** as disclosed in the present embodiment, may be implemented in any other embodiment of the present invention, including the lighting device **100** or the lighting device **200** as presented hereinabove. In such embodiments, a secondary optic may carried by the housing **110** or the housing **210** and may generally circumscribe the optic **120** or the optics **220**. Additionally, the secondary optic in such embodiments may form a fluid seal with the housing **110** or the housing **210**, thereby sealing the optic **120** or the optics **220** from the environment surrounding the lighting device **100** or the lighting device **200**.

Each primary optic **330** of the plurality of primary optics **330** may be substantially similar to the optics as depicted and described in the embodiments hereinabove. Accordingly, it may incorporate any or all of the features of the optics presented hereinabove. Each primary optic **330** may be configured to receive light from an associated light source **340** at a receiving surface **332** and redirect the received light so as to be emitted from one or more emitting surfaces **334**. In some embodiments a first emitting surface **336** may include a plurality of features **337** configured to redirect light in the direction of the second emitting surface **338**. The plurality of features **337** may be configured as any of the features described hereinabove.

The direction in which the second emitting surface **338** emits light may be determined in part by the placement of the primary optic **330** on the lower surface **312**. In the present embodiment, the second emitting surface **338** each primary optic **330** may be positioned such that light emitted therefrom in the direction of an edge **314** associated with the primary optic **330**. For example, a first primary optic **330'** may be positioned such that its second emitting surface **338** emits light in the direction of a first edge **314'**. Similarly, a second primary optic **330"** may be positioned such that its second emitting surface **338** emits light in the direction of a second edge **314"**. Similarly, each remaining primary optic **330** of the plurality of primary optics **330** may be positioned so as to emit light generally in the direction with and associated edge **314**. The edge **314** with which each primary optic **330** is associated with may be determined by the edge **314** that is associated with the light source **340** associated with the primary optic **330**. Accordingly, in some embodiments, each optic **330** may be associated with an edge **314**. In some embodiments, one primary optic **330** may be the only primary optic **330** of the plurality of primary optics **330** associated with a given edge **314**. In some embodiments, more than one primary optic **330** may be associated with a given edge **314**. In some embodiments, one primary optic **330** may be associated more than one edge **314**.

Furthermore, the plurality of primary optics **330** may be positioned such that the second emitting surface **338** of each primary optic **330** may emit light in a direction generally away from the center of the lower surface **312**. Additionally, the primary optics **330** may be positioned such that the second emitting surface **338** of each primary optic **330** may emit light in a direction generally towards the secondary optic **350**. More specifically, each primary optic **330** may be positioned such that the second emitting surface **338** may emit light in a direction generally towards a section **356** of the secondary optic **350** that is nearest the primary optic **330**. Where the secondary optic **350** generally conforms to the shape of the lower surface **312**, the second emitting surface **338** of each primary optic **330** may emit light in a direction generally towards a section **356** of the secondary optic **350** that is associated with the edge **314** associated with the primary optic **330**. For example, a first primary optic **330'** may be positioned such that light emitted by its second emitting surface **338** is emitted in the direction of a first section **356'** of the secondary optic **350**, and a second primary optic **330"** may be positioned such that light emitted by its second emitting surface **338** is emitted in the direction of a second section **356"** of the secondary optic **350**. The remaining primary optics **330** the plurality of primary optics **330** may be similarly positioned according to this pattern.

Similar to the light sources **340**, the plurality of primary optics **330** may be positioned so as to generally conform to the shape of the lower surface **312**. More specifically, the position of each primary optic **330** with relation to the other primary optics **330** may be similar to the position of the edge **314** associated with primary optic **330** with relation to the other edges **314**. Accordingly, in the present embodiment, the plurality of primary optics **330** is positioned into a generally box-like configuration. Any configuration and arrangement of the plurality of primary optics **330** is contemplated and included within the scope of the invention. More specifically, any configuration of the shape of the lower surface **312** may be reflected and generally adhered to in the positioning of the plurality of primary optics **330**. Accordingly, in some embodiments, the plurality of primary optics **330** may include a number of primary optics **330** equal to the number of sides defined by the shape of the lower surface **312**. In some embodiments, the plurality of primary optics **330** may include a number of primary optics **330** fewer than or more than the number of sides defined by the shape of the lower surface **312**.

The secondary optic **350** may be configured to permit the lower housing **320** to be attached thereto. Any means or methods of attachment may be employed to attach the lower housing **320** to the secondary optic **350**. The lower housing **320** may be attached to a lower section **354** of the secondary optic **350**. Moreover, the attachment of the lower housing **320** to the secondary optic **350** may permit the lower housing **320** to be carried by the secondary optic **350**. Furthermore, the attachment between the secondary optic **350** and the lower housing **320** may complete the definition of the optical chamber **360**. Additionally, the attachment between the secondary optic **350** and the lower housing **320** may form a fluid seal therebetween. Accordingly, in conjunction with the fluid seal formed between the secondary optic **350** and the lower surface **312** of the upper housing **310**, the fluid seal formed between the secondary optic **350** and the lower housing **320** may completely seal the optical chamber **360** fluidically from the environment surrounding the lighting device **300**, thereby preventing the occlusion of light resulting from attachment of environmental contaminant, such as dust or other particulate matter, upon the primary optics **330**.

Referring now to FIG. **6**, the lower housing **320** will now be discussed in greater detail. The lower housing **320** may include a first plurality of slanted edges **322**, a second plurality of slanted edges **324**, and an upper surface **326**. The upper surface **326** may contribute to the definition of the optical chamber **360**, defining a lower surface of the optical chamber **360**. In some embodiments, the first plurality of slanted edges **322** may be configured to interface with the lower section **354** of the secondary optic **350**. In some embodiments, the second plurality of slanted edges **324** may be configured to facilitate the positioning of the plurality of primary optics **330** within the optical chamber **360**. More specifically, the second plurality of slanted edges **324** may permit the plurality of primary optics **330** to extend generally downward beyond a plane defined by the upper surface **326**.

In some embodiments, the second plurality of slanted edges **324** may be configured to interface with the plurality of primary optics **330**. More specifically, the second plurality of slanted edges **324** may be slanted at an angle that is approximately equal to an angle formed by a taper **339** of the plurality of primary optics **330**. Furthermore, in some embodiments, the one or more of the plurality of primary optics **330** may be attached to the second plurality of slanted edges **324** according to any means a method known in the art. In such embodiments, the plurality of primary optics **330** may be positioned such that light emitted by the light sources **340** is effectively received by the receiving surface **332** the plurality of primary optics **330**. In some embodiments, the receiving surface **332** of each primary optic **330** may interface with a surface of the associated light source **340**. In some embodiments, the receiving surface **332** of each primary optic **330** may be offset from a surface of the associated light source **340**. In some embodiments, the light sources **340** may be configured to emit light in a direction generally towards the receiving surface **332** of the associated primary optic **330**.

Similar to the secondary optic **350**, it is contemplated and included within the scope of the invention that the lower housing **320** may be included in either of the embodiments of the invention presented herein above, specifically with either of the lighting device **100** with the lighting device **200**.

In some embodiments, the lower housing **320** may be formed of a material that is generally transparent or translucent. Furthermore, the lower housing **320** may be configured to refract, reflect, collimate, diffuse, or otherwise redirect light incident thereupon and passing therethrough. Additionally, in some embodiments, the lower housing **320** may include a color conversion layer as described hereinabove. In some embodiments, the lower housing **320** and the secondary optic **350** may be integrally formed as a single structural element.

Some of the illustrative aspects of the present invention may be advantageous in solving the problems herein described and other problems not discussed which are discoverable by a skilled artisan.

While the above description contains much specificity, these should not be construed as limitations on the scope of any embodiment, but as exemplifications of the presented embodiments thereof. Many other ramifications and variations are possible within the teachings of the various embodiments. While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best or only mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

Thus the scope of the invention should be determined by the appended claims and their legal equivalents, and not by the examples given.

What is claimed is:

1. An edge lit lighting device comprising:
- a rectangular prism shaped housing comprising an upper housing having a lower surface;
- a plurality of light sources attached to the lower surface; and
- a plurality of primary optics, each primary optic being associated with a light source of the plurality of light sources and positioned in optical communication with the associated light source, each primary optic comprising
  - a receiving surface positioned adjacent to the associated light source,
  - a first surface, and
  - a second emitting surface;
- wherein the primary optics are carried by the planar surfaces of the rectangular prism shaped housing;
- wherein the second emitting surface comprises a plurality of features configured to redirect light in the direction of the first surface;
- wherein the plurality of light sources and plurality of primary optics are positioned so as to emit light in the direction of a secondary optic; and
- wherein a primary optic of the plurality of primary optics is positioned so as to emit light in a direction approximately orthogonal to another primary optic of the plurality of primary optics.

2. The lighting device of claim **1** wherein at least two polygonal primary optics are oriented at angles of 90 degrees or greater with respect to each other.

3. The lighting device of claim **1** wherein the plurality of primary optics are attached to a lower housing.

4. The lighting device of claim **3** wherein each of the upper housing, the secondary optic, and the lower housing cooperate to define an optical chamber; and wherein the optical chamber is sealed fluidically from the environment surrounding the lighting device.

5. The lighting device of claim **1** wherein the secondary optic comprises a plurality of sections; wherein each primary optic of the plurality of primary optics is associated with a section of the plurality of sections of the secondary optic; and wherein each primary optic of the plurality of primary optics is configured to emit light in the direction of its associated section of the secondary optic.

6. The lighting device of claim **1** wherein the light source comprises a plurality light-emitting diodes (LEDs).

7. The lighting device of claim **6** wherein the plurality of LEDs are arranged into a geometric configuration corresponding to an arrangement of the plurality of primary optics.

8. The lighting device of claim **1** wherein the light source is configured to provide light generally uniformly across a length of the receiving surface of each primary optic of the plurality of primary optics.

9. The lighting device of claim **1** wherein each primary optic of the plurality of primary optics is configured to emit light from the second emitting surface generally uniformly in a left-to-right perspective.

10. The lighting device of claim **1** wherein each primary optic of the plurality of primary optics is configured to emit light from the second emitting surface generally uniformly in a top-to-bottom perspective.

11. The lighting device of claim **1** wherein the second emitting surface of the plurality of primary optics is substantially smooth.

12. The lighting device of claim **1** wherein the plurality of features comprises alternating generally horizontal sections and slanted sections.

13. The lighting device of claim **1** wherein at least one of the plurality of primary optics and the secondary optic comprises a color conversion layer configured to receive light within a first wavelength range and to emit light within a second wavelength range.

14. The lighting device of claim **1** wherein at least one primary optic of the plurality of primary optics has a generally rectangular configuration.

15. The lighting device of claim **1** wherein a primary optic of the plurality of primary optics is oriented at an angle of approximately 90 degrees from another primary optic of the plurality of primary optics.

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